ANNUAL REPORT, FY 2008 12 February 09

1. **Title:**

Demographic Characteristics of Northern Spotted Owls (*Strix occidentalis caurina*) in the Klamath Mountain Province of Oregon, 1985-2008.

2. **Principal Investigators and Organizations:**

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3. **Study Objectives:**

The study objectives are to estimate the population parameters of northern spotted owls on the Klamath Study Area (KSA) within the Klamath Mountain Province. These parameters include occupancy, survival and reproductive success. The lands are administered by the Glendale and South River Field Office of the Medford and Roseburg Districts of the USDI Bureau of Land Management (BLM).

4. **Potential Benefit or Utility of the Study:**

The KSA is one of 8 long-term northern spotted owl study areas designed to assess trends in spotted owl populations and habitat as directed under the Northwest Forest Plan (USDA and USDI 1994). The data from these studies through 2008 were analyzed at a rangewide workshop (Forsman et al. in prep). The survival and reproductive data will be used in population modeling to assess the long-term stability of the population (Franklin et al. 1999). Data from several study areas will be used in the development of habitat predictive models for the spotted owl (Lint et al. 1999, Anthony et al. 2000).

5. **Study Area Description and Survey Design:**

The study area is located within the Klamath Mountains Province in SW Oregon and is approximately 1422 km^2 (351,334 ac) in size. This province is characterized by mixed conifer forests dominated by Douglas-fir (*Pseudotsuga menziesii*) and incense cedar (*Calocedrus decurrens*). Other species common include pine (*Pinus* spp.), grand fir (*Abies grandis*), pacific madrone (*Arbutus menziesii*), golden chinquapin (*Castanopsis chrysophylla*), and oak (*Quercus* spp.) (Franklin and Dyrness 1973). Sites within the current boundaries of the KSA were systematically surveyed from 1997-present. A smaller study area (about 466 km^2; 115,138 ac) was intensively surveyed from 1990-1994 and is encompassed within the current boundaries.

The KSA includes portions of 2 BLM Districts in Western Oregon (Medford and Roseburg), and much of the intervening areas of private and state lands. The federal lands are in an alternating “checkerboard” pattern of ownership with private lands. Of the 8 long-term studies, 2 of them (Klamath and Tyee) are composed almost entirely of this checkerboard pattern of ownership. Two types of study areas are included in the 8 long-term studies, a density study area where all of the area within the boundary is surveyed each year, and a territorial study area where all past and present owl territories are surveyed each year. The KSA is a territory based study area.

The Northwest Forest Plan (NWFP) designates forestland into several Land Use Allocations (LUA's). One such LUA is designated Late Successional Reserve (LSR) and is designed to provide a functional late-successional and old growth forest ecosystem. Currently, BLM administered lands are being managed under the Western Oregon Plan Revision, and NWFP LUA do not apply. However, the study area includes part or all of 2 LSR areas formerly designated under the NWFP.

The checkerboard pattern makes analysis by ownership or LUA difficult as virtually all sites within an LSR designation also encompass non-LSR within their home range. For the purpose of this analysis, a line was drawn around each of the 2 LSR's in the study. If sites were located within these boundaries they were considered in LSR, even though the private land within these boundaries is not actually designated as LSR.

The study monitors demographic parameters including survival rates, reproductive rates, and annual rate of population change. The protocol currently used to determine site occupancy, nesting, and reproductive status for this study follows the guidelines specified by the Northern Spotted Owl Effectiveness Monitoring Plan for the Northwest Forest Plan (Lint et al. 1999). An attempt is made to uniquely color band or reobserve all previously banded individuals within the study. The reobservation of banded owls will be used for the calculation of survival rates and population trends (Franklin et al. 1999, Burnham et al. 1996, Anthony et al. 2006).

6. <u>Results for FY 2008</u>:

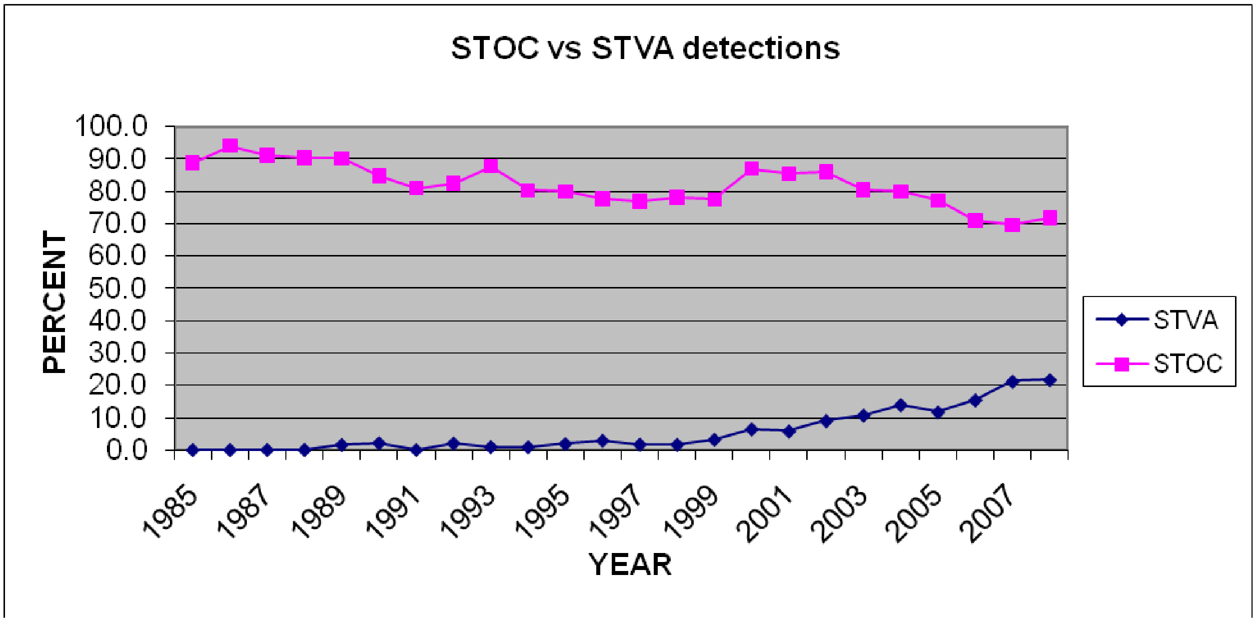
Survey Effort

There are currently 156 sites within the study area. During the period of study, it was determined that some sites that were considered separate sites were actually different use areas of the same site, these sites have been combined. Of the 156 sites surveyed during 2008; a pair occupied 79, a resident single occupied 13, and 20 were occupied by 1 or 2 owls with unknown status (Appendix A). At least one owl was detected at 112 (71.8 %) of the sites. During 2008, 1 new site was established within the study, initially it had been considered a different use area of a known site, however owl pairs were detected at those 2 use areas and it was subsequently split into 2 sites. Consistent occupancy by a territorial single or a pair is the usual criteria for designating a new site.

Owl Detections and Banding by Sex and Age

A total of 194 non-juvenile spotted owls were detected on the study area during 2008, 99 of which were males and 94 were females, resulting in a male:female sex ratio for non-juveniles of 1.05:1. Of the 174 non-juvenile owls on the study area where age was determined, 163 (93.7%) were adults and 11 (6.3%) were subadults (Appendix B). The oldest known owl within the study area was a male that was at least 20 years old. The oldest known female was 18 years old, banded as a juvenile on the study area in 1990. She was reobserved as an adult in 1996 and has been confirmed at the same site every year since. A total of 52 owls were newly banded on the study area during 2008. Of these, 46 (88.5%) were fledglings, 2 (3.8%) were subadults, and 4 (7.7%) were adults.

Figure 1. Percentage of sites surveyed with at least one spotted owl detection versus sites with at least one barred owl detection.



During 2008, of the 15 owls encountered for the first time as non-juveniles on the study, the ages of 11 (73.3%) were known exactly or within 1 year. On the study area, 1 non-juvenile was a known immigrant and 2 non-juveniles were known emigrants. A total of 8 owls originally banded as juveniles within the KSA were recaptured during 2008, 5 of them were recaptured within the KSA. The longest distance moved for a juvenile banded within the study and relocated during 2008 was 34.6 km (21.5 miles) from the point of original banding, and the longest distance moved for a non-juvenile banded within the study and relocated during 2008 was 21.2 km (13.2 mile) from the point of previous confirmation. The average distance for recoveries of dispersing males during 2008 was 20.8 km (12.9 miles) (N=5) and for females was 18.4 km (11.4 miles) (N=3).

There were 44 non-juvenile barred owls (*Strix varia*) detected on the study area during 2008. At 11 sites we detected a pair of barred owls and there was 1 known spotted-barred owl hybrid located within the study area. A comparison was made of the percentage of sites that were surveyed where at least one spotted owl was detected versus at least one barred owl detected (Figure 1). The barred owl detections were incidental to spotted owl surveys, therefore the number of sites with at least one barred owl detection probably underestimates the actual number. The percentage of sites surveyed for spotted owls with barred owl detections is trending upward from a fairly low 1.7% in 1998, to 15.5% in 2006, 21.3% in 2007, and 21.8% in 2008.

Reproduction

Yearly reproductive data (1985-2008) (Appendix C) includes nest success, fecundity rate, and mean brood size. The proportion of females nesting is defined as the number of females that attempted to nest compared to the total where nesting status was determined. Nest success is defined as the proportion of nesting females that fledged young. The fecundity rate is defined as the number of female young produced per female where the number of young produced was determined. The mean brood size is defined as the average number of young produced per successfully reproducing pair. Where appropriate, the data were split into 4 female age classes; 1-year old, 2-year old, adult, and unknown age. The reproductive data were analyzed 2 ways: 1) the entire study area, and 2) divided into 2 groups (LSR and non-LSR) (Appendix D).

During 2008, there were a total of 80 sites where pairs were detected and nesting status was determined, 45 nested (56.2%) and 35 did not nest (43.8%). Of the sites where nesting occurred during 2008, 36 pairs successfully fledged young and 9 pairs nested and failed, resulting in a nesting success rate of 80.0% (Appendix C).

The fecundity rate for 2008 was calculated at 0.315. The fecundity rate for the years 1985-2008 was split into 4 female age classes. The rate for 1-year olds (0.065) was much lower than 2-year olds (0.293), adults (0.370), and unknown (0.333) (Table 1). During 2008, of the 4 pairs with a female 1 year of age that were checked for fecundity, none attempted to nest.

The fecundity rate was compared between sites with barred owl detections and sites without barred owl detections. These numbers should be viewed with caution since barred owl detections were incidental to survey efforts for spotted owls. The first year barred owls were detected at any spotted owl site at which reproduction was determined was in 1999. The fecundity rate for the years 1999-2008 was 0.217 (0.119-0.316, N=46) for sites with barred owl presence, and 0.333 (0.304-0.362, N=803) for sites without barred owl presence. The fecundity rate during 2008 was 0.333 (N=9) for sites with barred owl presence, and 0.341 (N=69) for sites without barred owl presence. During 2008; the nest attempts were 44.4% (N=9), nest success was 75.0% (N=4), and brood size was 2.00 for sites with barred owl presence. During 2008; the nest attempts were 60.1% (N=69), nest success was 80.1% (N=42), and brood size was 1.38 for sites without barred owl presence.

In 2008, the mean brood size (1.43) was only slightly lower than the average for the years 1985-2008 (1.57). The mean brood size for the years 1985-2008 was split into 4 female age classes, all resulted in similar values (Table 1).

Table 1. Fecundity rate and mean brood size by age class within the KSA. Sites where backpack transmitters were attached to females during the nesting season were excluded from the calculation during the years of attachment. (a)

Age class	Mean fecundity (N), 1985-2008	95% CI for fecundity	Mean brood size (N), 1985-2008	95% CI for brood size
1-yr	0.065 (93)	0.000-0.145	1.67 (6)	1.28-2.06
2-yr	0.293 (140)	0.237-0.349	1.47 (55)	1.34-1.60
Adult	0.370 (1185)	0.345-0.395	1.59 (553)	1.55-1.63
Unk	0.333 (51)	0.222-0.445	1.36 (25)	1.16-1.56
Total	0.342 (1469)	0.320-0.364	1.57 (639)	1.53-1.61

(a) Preliminary data, values may change.

7. Discussion for FY 2008:

Survey Effort

The survey effort within the study area has varied over time, however the general trend has been an increase in the number of sites surveyed (Appendix A). The KSA boundaries were established in 1997 and the survey effort increased significantly at that time. There has been a leveling off in the number of sites located within the study area as much of the available habitat has been surveyed. Although most of the area within this boundary is covered by territorial surveys, it is not a density study and some areas may still not be surveyed.

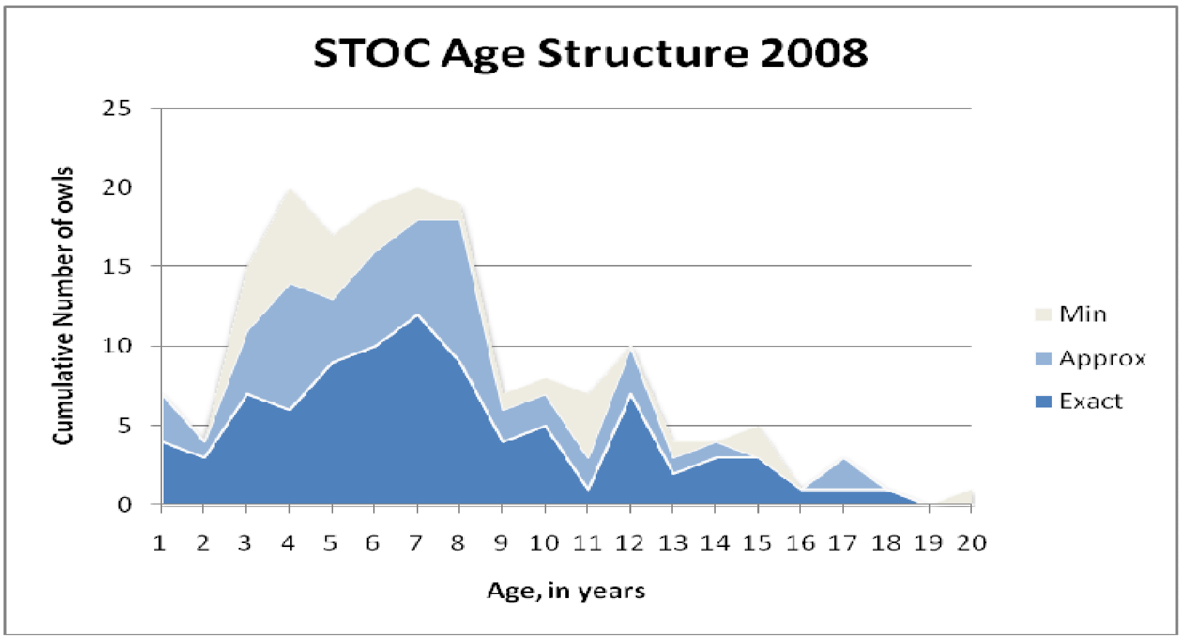
Owl Detections

The increase in individual owl detections through 2002 corresponds with the increase in the number of sites on the study area. The number of owls detected is not as variable and is no longer increasing rapidly as all possible owl sites were located, and has begun to decrease since the 2002 survey season. There has been a steady decline in the total number of non-juveniles detected (Appendix B) and an even larger decrease in the number of pairs detected (Appendix A). The decrease of the subadult age class is even more pronounced, from the highest proportion ever (24.1% in 2002, 25.9% in 2003) early in this decade to under 10% the past 4 years. This was the first time during the study that the proportion of subadults has remained under 10% for more than 2 consecutive years. Some of this may be explained by years with low fecundity (1993, 1995, 2006, 2007) corresponding to subsequent years with low numbers of subadults recruited into the population. Another indicator of recruitment is the number of juveniles banded on the study area surviving and being subsequently recaptured. The highest number of internal recruits was 20 in 2003 which was preceded by 3 consecutive years of very high fecundity rates. During 2008 there were only 5 previously banded juveniles recaptured, compared to 17 in 2007, 9 in 2006, and 12 in

2005. This apparent decrease in recruitment combined with the decrease in pair detection may be cause for concern.

A majority of the non-juvenile owls encountered for the first time (82.1% in 2007, 73.3% in 2008) were of known age or known within 1 year. This is a result of banding juveniles or locating new owls while they were still in the subadult age class. Knowing the age structure of the population allows flexibility for current and future analysis (Figure 2). Individuals of exact age were banded as juveniles, while those of approximate age were initially banded as subadults, and individuals of minimum age were initially banded as adults. The minimum age grouping should be viewed with caution, since the actual age at initial banding is an approximation and may vary considerably from 3-20 years. Most of the population is comprised of 4-8 year ages, which agrees with the results from Loschl (2008) whose data for an Oregon study showed that the average life span was 7-9 years.

Figure 2. Age structure of owls identified during 2008. The total owls in each age category are cumulative for each age grouping.

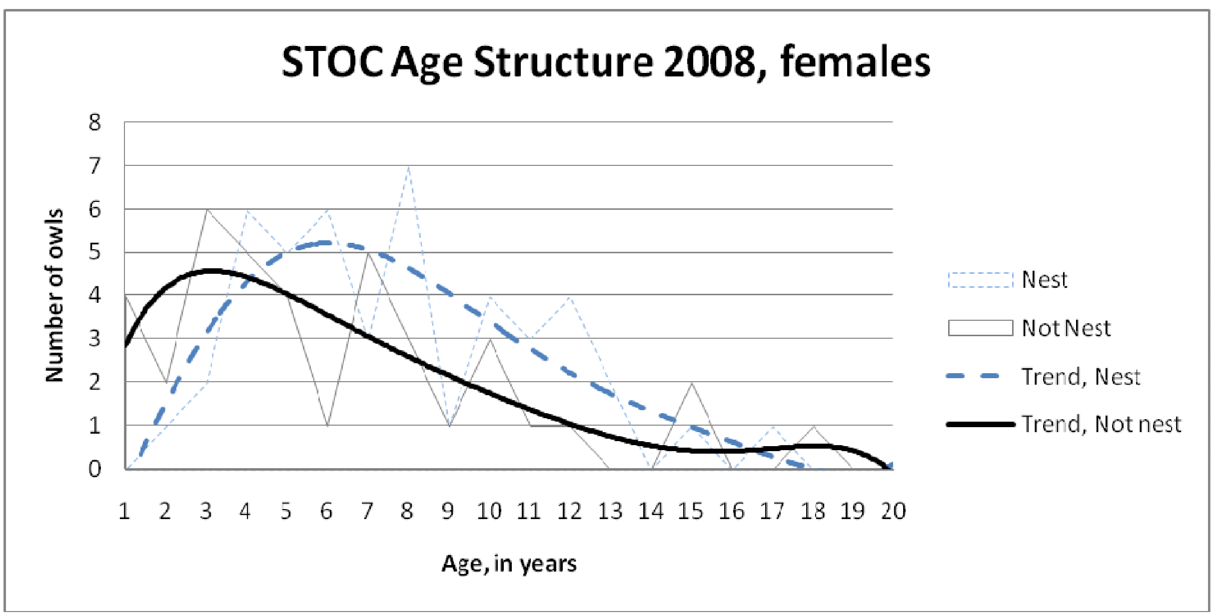


The 44 non-juvenile barred owls detected on the study area was similar to the number detected in 2007 (46), but was an increase from the numbers detected during most previous years. Using simple presence at a site, there was a proportional increase in barred owl detections during the last few years. Barred owl detection may be less likely at sites occupied by spotted owls. These sites tend to receive more focused diurnal visits and less complete coverage of the territory compared to unoccupied sites which are thoroughly surveyed at least 3 nights. Therefore, the number of sites with at least one barred owl detection probably underestimates the actual number of barred owls present, especially at sites with spotted owl detections. Figure 1 indicates the increase in barred owl detections at surveyed sites corresponding to a decrease in spotted owl detections at these sites. It has been postulated that the spotted owl population will experience internal movements in reaction to barred owl disruption of territories. Data on adult movements within the study were fairly consistent over recent time, 14 movements in 2008, 16 in 2007, 13 in 2006, and 13 in 2005. This indicates disruption may not have occurred yet, but the level of barred owl presence seems to be increasing. There has been a rapid increase in barred owl detections at the Tyee Density study area north of the KSA (Forsman et al 2007). The graph in Figure 1 appears similar to the Tyee data through 2002, indicating the barred owls will continue to increase in the KSA as well. It is probable that barred owls will continue their expansion south affecting spotted owl detections and population trends (Kelly 2001).

Demographics

The nesting status was determined at 80 (95.2%) of the sites where reproduction was eventually determined. The last several years have had a consistently high rate of nest status determination (2007, 94.3%). Locating nesting pairs before 1 June is not required to determine reproduction, but it has several benefits. One benefit is a more accurate determination of nest success, which is the number of pairs that attempted to nest and actually fledged young. Another benefit is a more accurate count of the number of young fledged. If the nest tree location is known, reproductive visits can be timed soon after fledging occurs to avoid the effects of early juvenile mortality which would lead to the undercounting of nesting success.

Figure 3. Age structure of females where nesting status was determined. Comparison of nesting versus not nesting, with a 6 interval polynomial bolded trend line fit to the data.



The nest success rate for 2008 was 80.0% and compares to the average of 78% from 1985-2008 (Appendix C). A lower than average nest success occurred during 2005-2007, the reasons are unknown. In addition, the 2008 mean brood size was 1.43 and was lower than the average for all years of 1.58 (Appendix C). The higher brood size from 2005-2007 may partially offset the lower nest success during that time period. Figure 3 illustrates the difference in age structure during 2008 when comparing individual females who did not attempt to nest versus those that attempted to nest. There were fewer nesting attempts among the younger age classes (approx 1-4 year) and more nesting attempts among the middle age classes (approx 4-8 year). This agrees with Loschl's (2008) data for a study area in the Oregon Coast Range, that determined the cumulative percent of an owls first breeding age for females was about 50% by age 3, increasing to almost 100% by age 6.

The fecundity rate for 2008 was 0.315, and was slightly lower than the average for the years 1985-2008 (0.342). While the fecundity rate is known to fluctuate, we documented only 1 year during the most recent 5 years where the fecundity rate was above the overall average. In addition, the number of pairs at sites has declined during that time period, and the number of unoccupied sites has increased. The number of sites surveyed during this period has remained relatively constant. We documented a gradually increasing fecundity rate from 1-year old to adult age classes. Our most recent analysis shows a very low fecundity rate for 1-year olds, while the rate for 2-year olds and adults are quite similar (Table 1). Although fecundity rates varied by age class, the mean brood sizes did not appear to differ greatly among age classes. The number of juveniles detected within the study area during 2008 (53) was near the overall median (Appendix B). The nest success, fecundity rate, and mean brood size for the early years (1985-1988) were calculated from small sample sizes and at a time when a well documented protocol did not exist, therefore results from those years may not be comparable to more recent data.

We compared fecundity rates at sites with and without barred owl detections from 1999-2008. Because barred owl detections were incidental, the results at sites where spotted owl reproduction was determined may be biased low regarding barred owl detections. However, the bias for reproductive versus non reproductive sites should be somewhat similar since most visits occur diurnally and comparing the two may be valid. The fecundity rate at sites with known barred owl presence was 0.217 compared to 0.333 at sites where barred owls were not detected. There was very little overlap in confidence intervals for these estimates. The fecundity rate using only the 2008 data at sites with known barred owl presence was 0.333 compared to 0.341 at sites where barred owls were not detected. These cumulative year data indicate barred owl presence may have a negative impact on spotted owl reproduction and agree with findings from Olson et al 2004, however the results were not as pronounced when using data only from 2008.

The yearly fecundity rates for sites within an LSR compared to sites outside the LSR boundary are given in Appendix D. Currently, BLM administered lands are being managed under the Western Oregon Plan Revision and NWFP LUA do not apply, but comparing the areas is still useful since the land management activities followed the NWFP during the study time period. The NWFP became effective in the spring of 1994, therefore the data are also presented for the combined years before the effective date and for the combined years after the effective date. Fecundity rates at LSR sites compared to non-LSR sites both before and after the NWFP implementation indicate similar rates. There was a slight decrease in fecundity after the NWFP implementation for both LSR (0.401 versus 0.323) and non-LSR

(0.390 versus 0.327) sites. In recent years, the number of sites where fecundity was determined has decreased on both LSR and non-LSR sites, indicating there may be a population decline in both. Currently the quantity of timber harvested on federal non-LSR forest is quite minimal. In addition, the private land harvest has occurred at about the same rate within the LSR boundary and outside of the boundary. The differences may be more meaningful as more timber is harvested from non-LSR federal land.

8. Acknowledgments:

Many people and organizations contributed to the success of this project. Without the dozens of dedicated people collecting the field data, none of this could have been accomplished. In addition, biologists from surrounding areas have contributed information regarding owl movements. Several private timber companies have been gracious enough to allow access to sites on their property. The primary government agencies involved in the Klamath Study Area are the BLM and the State of Oregon. Funding for rangewide demographic studies comes from BLM, USDA Forest Service, and the National Park Service.

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Appendix A. Territories surveyed and occupancy results by year within the KSA (1985-2008). (a)

Year	Total Sites (b)	Sites w/ STVA (c)	Sites w/ Pair (d)	Sites w/ single	Sites w/ undetermined status (e)	Total occupied sites	Sites w/ no occupation (f)	Sites w/ incomplete survey (g)
1985	9	0	6	1	1	8	1	0
1986	17	0	13	2	1	16	1	0
1987	34	0	24	3	4	31	3	3
1988	42	0	30	3	5	38	4	7
1989	62	1	39	8	9	56	5	5
1990	93	2	58	10	11	79	14	7
1991	95	0	61	11	5	77	18	11
1992*	97	2	58	13	9	80	17	11
1993*	107	1	66	15	13	94	13	9
1994*	112	1	73	4	13	90	22	9
1995*	105	2	60	11	13	84	18	17
1996	103	3	58	7	15	80	21	19
1997	117	2	61	12	17	90	25	9
1998*	119	2	74	9	10	93	22	11
1999*	125	4	74	9	14	97	25	7
2000*	124	8	71	16	21	108	12	9
2001*	138	8	86	12	16	118	20	1
2002	144	13	96	10	18	124	16	1
2003	149	16	95	11	14	120	21	0
2004	150	21	96	10	14	120	26	0
2005	153	18	91	13	14	118	31	1
2006	155	24	89	10	11	110	36	1
2007	155	33	81	16	11	108	38	1
2008	156	34	79	13	20	112	36	0

(a) Preliminary data, values may change.
(b) Sites surveyed to protocol. The sum of the last 3 columns may not equal the total sites since sites with the same individual located at 2 sites are not considered as occupied at one site.
(c) STVA occupancy is opportunistic and is defined as any detection at the site.
(d) Pair as defined in Lint et al 1999.
(e) Undetermined status may include one or 2 owls, does not qualify as a pair or single.
(f) No occupancy determined with at least 3 survey visits.
(g) Incomplete survey is 2 visits or less (usually no visits, only includes sites surveyed in previous years).
* represents years with a site where the pair was comprised of a spotted owl and a barred owl which was included as a “site with single”.

Appendix B. Sex and age composition of spotted owls located within the KSA (1985-2007). Non-juvenile owls where the sex could not be determined are not included. (a)

Year	Adult (M,F)	Subadult (M,F)	Percent Subadult	Age unk (M,F) (b)	Total non-juvenile (M,F)	Juvenile
1985	10 (6,4)	0 (0,0)	0.0	5 (2,3)	15 (8,7)	6
1986	17 (10,7)	1 (1,0)	5.6	10 (4,6)	28 (15,13)	18
1987	32 (19,13)	9 (5,4)	22.0	16 (6,10)	57 (30,27)	8
1988	43 (26,17)	12 (4,8)	21.8	13 (7,6)	68 (37,31)	17
1989	76 (42,34)	6 (3,3)	7.3	18 (10,8)	100 (55,45)	18
1990	100 (56,44)	14 (8,6)	12.3	22 (12,10)	136 (76,60)	52
1991	112 (61,51)	16 (7,9)	12.5	14 (8,6)	142 (76,66)	40
1992	106 (61,45)	16 (6,10)	13.1	18 (11,7)	140 (78,62)	59
1993	117 (63,54)	23 (12,11)	16.4	23 (16,7)	163 (91,72)	22
1994	125 (67,58)	28 (13,15)	18.3	15 (8,7)	168 (88,80)	55
1995	118 (65,53)	9 (1,8)	7.1	20 (15,5)	147 (81,66)	18
1996	112 (61,51)	8 (4,4)	6.7	26 (14,12)	146 (79,67)	56
1997	114 (59,55)	22 (15,7)	16.2	26 (12,14)	162 (86,76)	52
1998	124 (67,57)	27 (14,13)	17.9	19 (9,10)	170 (90,80)	41
1999	131 (72,59)	16 (5,11)	10.9	31 (16,15)	178 (93,85)	44
2000	135 (74,61)	18 (9,9)	11.8	32 (19,13)	185 (102,83)	65
2001	148 (77,71)	34 (19,15)	18.7	18 (13,5)	200 (109,91)	82
2002	154 (84,70)	49 (21,28)	24.1	19 (13,6)	222 (118,104)	83
2003	152 (84,68)	53 (25,28)	25.9	12 (8,4)	217 (117,100)	38
2004	173 (93,80)	28 (11,17)	13.9	18 (13,5)	216 (115,101)	75
2005	192 (105,87)	17 (3,14)	8.2	6 (6,0)	215 (114,101)	61
2006	168 (91,77)	18 (3,15)	9.7	14 (10,4)	200 (104,96)	35
2007	159 (82,77)	16 (7,9)	9.1	14 (9,5)	189 (98,91)	19
2008	163 (83,80)	11 (4,7)	6.3	19 (12,7)	193 (99,94)	53

(a) Preliminary data, values may change.
(b) It is possible some of the unknown are auditory responses and the same individuals as another category.

Appendix C. Fecundity rate and mean brood size by year within the KSA (1985-2008). Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. (a)

Year	Nest success (N)	95% CI for Nest Success	Mean fecundity (N)	95% CI for fecundity	Mean brood size (N)	95% CI for brood size
1985	1.00 (4)	NA**	0.750 (4)	0.467-1.033	1.50 (4)	0.93-2.07
1986	1.00 (6) (64)	NA**	0.813 (8)	0.555-1.070	1.86 (7)	1.58-2.14
1987*	1.00 (4)	NA**	0.286 (14)	0.063-0.509	1.60 (5)	1.12-2.08
1988*	1.00 (12)	NA**	0.472 (18)	0.287-0.658	1.42 (12)	1.13-1.71
1989*	0.75 (8)	0.43-1.07	0.296 (27)	0.146-0.447	1.45 (11)	1.15-1.76
1990*	0.75 (28)	0.59-0.91	0.500 (48)	0.376-0.624	1.60 (30)	1.42-1.78
1991*	0.70 (30)	0.53-0.87	0.357 (56)	0.238-0.476	1.67 (24)	1.44-1.89
1992*	0.87 (31)	0.75-0.99	0.538 (52)	0.422-0.655	1.51 (37)	1.32-1.71
1993	0.75 (16)	0.53-0.97	0.186 (59)	0.098-0.275	1.47 (15)	1.21-1.73
1994	0.81 (31)	0.67-0.95	0.400 (70)	0.288-0.512	1.81 (31)	1.64-1.97
1995	0.67 (18)	0.44-0.89	0.158 (57)	0.076-0.240	1.38 (13)	1.11-1.66
1996	0.84 (32)	0.72-0.97	0.491 (57)	0.386-0.597	1.47 (38)	1.31-1.63
1997	0.96 (27)	0.89-1.04	0.433 (60)	0.316-0.551	1.73 (30)	1.57-1.89
1998	0.63 (32)	0.45-0.80	0.289 (71)	0.202-0.376	1.37 (30)	1.19-1.54
1999	0.88 (25)	0.75-1.01	0.338 (65)	0.231-0.446	1.69 (26)	1.51-1.87
2000	0.84 (45)	0.74-0.95	0.464 (70)	0.366-0.563	1.51 (43)	1.36-1.66
2001	0.85 (53)	0.75-0.95	0.488 (84)	0.387-0.589	1.78 (46)	1.66-1.90
2002	0.85 (60)	0.76-0.94	0.432 (96)	0.344-0.520	1.60 (52)	1.46-1.73
2003	0.60 (42)	0.44-0.75	0.205 (95)	0.137-0.273	1.34 (29)	1.17-1.52
2004	0.85 (54)	0.76-0.95	0.399 (94)	0.312-0.486	1.56 (48)	1.42-1.70
2005	0.62 (53)	0.49-0.75	0.302 (101)	0.220-0.384	1.60 (38)	1.45-1.76
2006	0.61 (33)	0.44-0.78	0.190 (92)	0.116-0.264	1.59 (22)	1.38-1.80
2007	0.69 (16)	0.45-0.92	0.110 (87)	0.047-0.174	1.73 (11)	1.45-2.00
2008	0.80 (45)	0.68-0.93	0.315(84)	0.231-0.400	1.43(37)	1.27-1.59
1985-2008	**0.78 (695)**	**0.75-0.81**	**0.342 (1469)**	**0.320-0.364**	**1.57 (639)**	**1.53-1.61**

(a) Preliminary data, values may change.

Appendix D. Fecundity rate and mean brood size by Land Use Allocation and year within the KSA. Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. (a)

Year	LSR, Mean fecundity (N)	LSR, 95% CI for fecundity	Non-LSR, Mean fecundity (N)	Non-LSR, 95% CI for fecundity
1985	0.667 (3)	0.340-0.993		
1986	0.700 (5)	0.308-1.092		
1987*	0.273 (11)	0.030-0.515	0.333 (3)	0.000-0.987
1988*	0.409 (11)	0.187-0.631	0.571 (7)	0.238-0.905
1989*	0.324 (17)	0.119-0.528	0.250 (10)	0.031-0.469
1990*	0.462 (26)	0.290-0.633	0.545 (22)	0.364-0.727
1991*	0.411 (28)	0.243-0.578	0.304 (28)	0.134-0.473
1992*	0.589 (28)	0.422-0.757	0.479 (24)	0.318-0.640
1993	0.214 (28)	0.077-0.352	0.161 (31)	0.046-0.276
1994	0.357 (35)	0.194-0.521	0.443 (35)	0.288-0.597
1995	0.145 (31)	0.032-0.258	0.173 (26)	0.052-0.294
1996	0.500 (32)	0.361-0.639	0.480 (25)	0.315-0.645
1997	0.533 (30)	0.371-0.696	0.333 (30)	0.168-0.498
1998	0.303 (33)	0.183-0.423	0.276 (38)	0.150-0.403
1999	0.333 (33)	0.176-0.491	0.344 (32)	0.195-0.493
2000	0.444 (36)	0.305-0.584	0.485 (34)	0.345-0.626
2001	0.500 (43)	0.362-0.638	0.476 (41)	0.327-0.625
2002	0.489 (46)	0.358-0.620	0.380 (50)	0.263-0.497
2003	0.196 (46)	0.092-0.299	0.214 (49)	0.124-0.305
2004	0.409 (44)	0.273-0.545	0.390 (50)	0.277-0.503
2005	0.211 (45)	0.106-0.317	0.375 (56)	0.257-0.493
2006	0.115 (39)	0.024-0.207	0.245 (53)	0.138-0.353
2007	0.053 (38)	0.000-0.125	0.156 (49)	0.060-0.253
2008	0.311(37)	0.191-0.430	0.319(47)	0.200-0.438
1985-1994	**0.401 (192)**	**0.338-0.464**	**0.390 (164)**	**0.323-0.458**
1995-2008	**0.323 (533)**	**0.287-0.358**	**0.327 (580)**	**0.293-0.361**
1985-2008	**0.343 (725)**	**0.312-0.375**	**0.341 (744)**	**0.311-0.372**

(a) Preliminary data, values may change.